E.) REMARKS

This Response is filed in response to the Office Action dated February 26, 2004.

Upon entry of this Response, claims 1-20 will be pending in the Application.

In the outstanding Office Action, the Examiner objected to the drawings; rejected claims 7, 9-11, 14, 15, 19 and 20 under 35 U.S.C. 112, second paragraph, as being indefinite; rejected claims 1-3, 6-9, 13-20 under 35 U.S.C. 102(a) as being anticipated by the Barka et al. article entitled "Scattering from 3-D Cavities with a Plug and Play Numerical Scheme Combining IE, PDE, and Modal Techniques;" rejected claims 1-3, 6-9, 13-20 under 35 U.S.C. 102(b) as being anticipated by the Ross et al. article entitled "Overlapping Geometric and Modal Symmetries in Jet Engine Scattering and Modulation;" rejected claims 4 and 5 under 35 U.S.C. § 103(a) as being unpatentable over the Ross et al. article in view of the Kameari article entitled "Symmetric Second Order Edge Elements for Triangles and Tetrahedra;" rejected claim 12 under 35 U.S.C. § 103(a) as being unpatentable over the Ross et al. article in view of the Greenwood et al. article entitled "A Novel Efficient Algorithm for Scattering from a Complex BOR Using Mixed Finite Elements and Cylindrical PML;" and rejected claims 10 and 11 under 35 U.S.C. § 103(a) as being unpatentable over the Ross et al. article in view of the Lowther et al. article entitled "A Finite Element Technique for Solving 2-D Open Boundary Problems."

Rejection under 35 U.S.C. 102

The Examiner rejected claims 1-3, 6-9, 13-20 under 35 U.S.C. 102(a) as being anticipated by the Barka et al. article entitled "Scattering from 3-D Cavities with a Plug and Play Numerical Scheme Combining IE, PDE, and Modal Techniques," hereinafter referred to as "the Barka Article."

Specifically, the Examiner stated that

> Borka et al teaches a radical reduction in the complexity of the model for radar and modulation form jet engines, which encompass using finite element method (FEM) and radar cross section (RCS) to obtain a 3-D representation of the aircraft engine (see sections II-III).

Applicants respectfully traverse the rejection of claims 1-3, 6-9, 13-20 under 35 U.S.C. 102(a).

The Barka Article, as understood, is directed to a multidomain and multimethod coupling scheme based on generalized scattering matrix computations that uses waveguide modes as expansion functions on the fictitious surfaces for modeling the field propagation from the cavity aperture down to the cavity termination. The generalized scattering matrix is computed with different methods including the electric field integral equation.

In contrast, independent claim 1 recites a method of calculating a radar cross section of an aircraft component having an axi-periodic structure comprising the steps of: creating a finite element model for the aircraft component describing electromagnetic characteristics of the aircraft component; transforming the finite element model into a plurality of independent modes; determining, for each independent mode of the plurality of independent modes, a portion of an electromagnetic field contributed by each independent mode; summing the portion of the electromagnetic field contributed by each independent mode of the plurality of independent modes to calculate a total electromagnetic field for the aircraft component; and determining the radar cross section for the aircraft component from the total electromagnetic field.

Independent claim 13 recites a computer program product embodied on a computer readable medium and executable by a computer for calculating the radar cross section (RCS) of an aircraft engine face component, the computer program product comprising computer instructions for executing the steps of: creating a finite element model for the aircraft engine face component describing electromagnetic characteristics of the aircraft engine face component; transforming the finite element model into a plurality of independent modes; determining, for each independent mode of the plurality of independent modes, a portion of an electromagnetic field contributed by each independent mode; summing the portion of the electromagnetic field contributed by each independent mode of the plurality of independent modes to calculate a total electromagnetic far-field for the aircraft engine face component; and determining the radar cross section for the aircraft engine face component from the total electromagnetic far-field.

Independent claim 17 recites a system for calculating the radar cross section (RCS) of an aircraft engine component comprising: a computer having memory and a processing unit; means for creating a finite element model for the aircraft engine component describing electromagnetic characteristics of the aircraft engine component; means for transforming the finite element model

into a plurality of independent modes; means for determining, for each independent mode of the plurality of independent modes, a portion of an electromagnetic near-field contributed by each independent mode; and means for summing the portion of the electromagnetic near-field contributed by each independent mode of the plurality of independent modes to calculate a total electromagnetic near-field for the aircraft engine component; means for determining a total electromagnetic far-field for the aircraft engine component from the total electromagnetic near-field for the aircraft engine component; and means for determining the radar cross section for the aircraft engine component from the total electromagnetic far-field.

To begin, the examiner is reminded that "'[a] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.' *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987)." *See* Manual of Patent Examining Procedure, 8th Edition (MPEP), Section 2131.

Several of the features recited by Applicant in independent claims 1, 13 and 17 are not taught or suggested by the Barka Article. First, the Barka Article does not teach or suggest transforming the finite element model into a plurality of independent modes as recited by Applicant in independent claims 1, 13 and 17. The Barka Article does not teach or suggest any transformation of a finite element model for the component into a plurality of independent modes. The Barka Article, as understood, is attempting to obtain some computational savings from manipulation of the waveguide mode functions, which is not Applicant's invention as recited in independent claims 1, 13 and 17. The Examiner asked to cite the explicit passage(s) in the Barka Article that would teach or suggest transforming the finite element model into a plurality of independent modes. Thus, since the Barka Article does not teach or suggest all of the limitations recited in independent claims 1, 13 and 17, Applicant respectfully submits that the Barka Article does not anticipate Applicant's invention as recited in independent claims 1, 13 and 17.

Furthermore, the Barka Article does not teach or suggest additional features recited by Applicant in independent claims 1, 13 and 17, including, determining, for each independent mode of the plurality of independent modes, a portion of an electromagnetic field contributed by

each independent mode; summing the portion of the electromagnetic field contributed by each independent mode of the plurality of independent modes to calculate a total electromagnetic field for the aircraft component; and determining the radar cross section for the aircraft component from the total electromagnetic field. Again, the Examiner asked to cite the explicit passage(s) in the Barka Article that would teach or suggest these features. Thus, since the Barka Article does not teach or suggest all of the limitations recited in independent claims 1, 13 and 17, Applicant respectfully submits that the Barka Article does not anticipate Applicant's invention as recited in independent claims 1, 13 and 17.

Therefore, for the reasons given above, independent claims 1, 13 and 17 are believed to be distinguishable from the Barka Article and therefore are not anticipated nor rendered obvious by the Barka Article.

Dependent claims 2, 3, 6-9, 14-16 and 18-20 are believed to be allowable as depending from what are believed to be allowable independent claims 1, 13 and 17 for the reasons given above. In addition, claims 2, 3, 6-9, 14-16 and 18-20 recite further limitations that distinguish over the applied art. In conclusion, it is respectfully submitted that claims 1-3, 6-9, 13-20 are not anticipated nor rendered obvious by the Barka Article and are therefore allowable.

The Examiner rejected claims 1-3, 6-9, 13-20 under 35 U.S.C. 102(b) as being anticipated by the Ross et al. article entitled "Overlapping Geometric and Modal Symmetries in Jet Engine Scattering and Modulation," hereinafter referred to as "the Ross Article." It is noted at this time that the Examiner did not explicitly identify which of the three Ross Articles cited by the Examiner in the Notice of References Cited was being applied, but, since only one Ross Article (the one identified above) satisfied the Examiner's citations, that article was analyzed in preparing this response.

Specifically, the Examiner stated that

> Ross et al teaches a radical reduction in the complexity of the model for radar and modulation form jet engines, which encompass using finite element method (FEM) (pg. 31, paragraph 2) and radar cross section (RCS) to obtain a 3-D representation of the aircraft engine (see figures 1-4).

Applicants respectfully traverse the rejection of claims 1-3, 6-9, 13-20 under 35 U.S.C. 102(b).

The Ross Article, as understood, is directed to the use of a limited mode phenomenon for a model for radar scattering and modulation from jet engines. The overlapping symmetry between incoming modes and the angularly periodic engine face give rise to a very sparse set of possible scattered modes. When the incoming modes are expressed with angular dependence, the set of possible scattered modes are seen to have a constant phase shift across an angular slice of a predetermined number of degrees.

In contrast, independent claim 1 recites a method of calculating a radar cross section of an aircraft component having an axi-periodic structure comprising the steps of: creating a finite element model for the aircraft component describing electromagnetic characteristics of the aircraft component; transforming the finite element model into a plurality of independent modes; determining, for each independent mode of the plurality of independent modes, a portion of an electromagnetic field contributed by each independent mode; summing the portion of the electromagnetic field contributed by each independent mode of the plurality of independent modes to calculate a total electromagnetic field for the aircraft component; and determining the radar cross section for the aircraft component from the total electromagnetic field.

Independent claim 13 recites a computer program product embodied on a computer readable medium and executable by a computer for calculating the radar cross section (RCS) of an aircraft engine face component, the computer program product comprising computer instructions for executing the steps of: creating a finite element model for the aircraft engine face component describing electromagnetic characteristics of the aircraft engine face component; transforming the finite element model into a plurality of independent modes; determining, for each independent mode of the plurality of independent modes, a portion of an electromagnetic field contributed by each independent mode; summing the portion of the electromagnetic field contributed by each independent mode of the plurality of independent modes to calculate a total electromagnetic far-field for the aircraft engine face component; and determining the radar cross section for the aircraft engine face component from the total electromagnetic far-field.

Independent claim 17 recites a system for calculating the radar cross section (RCS) of an aircraft engine component comprising: a computer having memory and a processing unit; means for creating a finite element model for the aircraft engine component describing electromagnetic

characteristics of the aircraft engine component; means for transforming the finite element model into a plurality of independent modes; means for determining, for each independent mode of the plurality of independent modes, a portion of an electromagnetic near-field contributed by each independent mode; and means for summing the portion of the electromagnetic near-field contributed by each independent mode of the plurality of independent modes to calculate a total electromagnetic near-field for the aircraft engine component; means for determining a total electromagnetic far-field for the aircraft engine component from the total electromagnetic near-field for the aircraft engine component; and means for determining the radar cross section for the aircraft engine component from the total electromagnetic far-field.

To begin, the examiner is reminded that "'[a] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.' *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987)." *See* Manual of Patent Examining Procedure, 8th Edition (MPEP), Section 2131.

Several of the features recited by Applicant in independent claims 1, 13 and 17 are not taught or suggested by the Ross Article. First, the Ross Article does not teach or suggest transforming the finite element model into a plurality of independent modes as recited by Applicant in independent claims 1, 13 and 17. The Ross Article does not teach or suggest any transformation of a finite element model for the component into a plurality of independent modes. The Ross Article, as understood, is attempting to obtain computational savings from manipulation of the incident wave (or incoming modes), which is not Applicant's invention as recited in independent claims 1, 13 and 17. The Examiner asked to cite the explicit passage(s) in the Ross Article that would teach or suggest transforming the finite element model into a plurality of independent modes. Thus, since the Ross Article does not teach or suggest all of the limitations recited in independent claims 1, 13 and 17, Applicant respectfully submits that the Ross Article does not anticipate Applicant's invention as recited in independent claims 1, 13 and 17.

Furthermore, the Ross Article does not teach or suggest additional features recited by Applicant in independent claims 1, 13 and 17, including, determining, for each independent

mode of the plurality of independent modes, a portion of an electromagnetic field contributed by each independent mode; summing the portion of the electromagnetic field contributed by each independent mode of the plurality of independent modes to calculate a total electromagnetic field for the aircraft component; and determining the radar cross section for the aircraft component from the total electromagnetic field. Again, the Examiner asked to cite the explicit passage(s) in the Ross Article that would teach or suggest these features. Thus, since the Ross Article does not teach or suggest all of the limitations recited in independent claims 1, 13 and 17, Applicant respectfully submits that the Ross Article does not anticipate Applicant's invention as recited in independent claims 1, 13 and 17.

Therefore, for the reasons given above, independent claims 1, 13 and 17 are believed to be distinguishable from the Ross Article and therefore are not anticipated nor rendered obvious by the Ross Article.

Dependent claims 2, 3, 6-9, 14-16 and 18-20 are believed to be allowable as depending from what are believed to be allowable independent claims 1, 13 and 17 for the reasons given above. In addition, claims 2, 3, 6-9, 14-16 and 18-20 recite further limitations that distinguish over the applied art. In conclusion, it is respectfully submitted that claims 1-3, 6-9, 13-20 are not anticipated nor rendered obvious by the Ross Article and are therefore allowable.

Rejection under 35 U.S.C. 103

The Examiner rejected claims 4 and 5 under 35 U.S.C. § 103(a) as being unpatentable over the Ross Article in view of the Kameari article entitled "Symmetric Second Order Edge Elements for Triangles and Tetrahedra," hereafter referred to as "the Kameari Article."

Specifically, the Examiner stated that

> Ross et al teaches a radical reduction in the complexity of the model for radar and modulation form jet engines, which encompass using finite element method (FEM) (pg. 31, paragraph 2) and radar cross section (RCS) to obtain a 3-D representation of the aircraft engine (see figures 1-4); but does not teach second order edge elements.
>
> Kameari teaches a new type of second order elements for simplexes with nodes and edges being 14 and 24 respectively, in a tetrahedral environment (abstract).
>
> One of ordinary skill in the art at the time of invention would have modified the teachings of Ross in view of Kameari, since it would be advantageous for proper spacing between nodes (Kameari: pg. 1397, conclusion,

lines 1-5) which are centered for capturing each sector of the aircraft (Barka: pg 705, column 2, lines 1-12).

Applicants respectfully traverse the rejection of claims 4 and 5 under 35 U.S.C. § 103(a).

The Ross Article is directed to the use of a limited mode phenomenon for a model for radar scattering and modulation from jet engines as discussed in greater detail above.

The Kameari Article, as understood, is directed to a type of second order edge element.

Applicant submits that dependent claims 4 and 5 are distinguishable from the Ross Article and/or the Kameari Article for at least the following reasons. To begin, dependent claims 4 and 5 are believed to be distinguishable from the Ross Article and/or the Kameari Article as depending from what is believed to be allowable independent claim 1 as discussed above. Furthermore, there is nothing in the Kameari Article that teaches or suggests any of the limitations in independent claim 1 not taught or suggested by the Ross Article.

Applicant respectfully submits that the Examiner has improperly combined the Ross Article and the Kameari Article. "The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art suggests the desirability of the combination." *See* Manual of Patent Examining Procedure, 8th Edition (MPEP), Section 2143.01.

Therefore, in view of the above, dependent claims 4 and 5 are believed to be distinguishable from the Ross Article and/or the Kameari Article and therefore are not anticipated nor rendered obvious by the Ross Article and/or the Kameari Article. In addition, claims 4 and 5 recite further limitations that distinguish over the applied art. In conclusion, it is respectfully submitted that claims 4 and 5 are not anticipated nor rendered obvious by the Ross Article and/or the Kameari Article and are therefore allowable.

The Examiner rejected claim 12 under 35 U.S.C. § 103(a) as being unpatentable over the Ross Article in view of the Greenwood et al. article entitled "A Novel Efficient Algorithm for Scattering from a Complex BOR Using Mixed Finite Elements and Cylindrical PML," hereafter referred to as "the Greenwood Article."

Specifically, the Examiner stated that

> Ross et al teaches a radical reduction in the complexity of the model for radar and modulation form jet engines, which encompass using finite element

> method (FEM) (pg. 31, paragraph 2) and radar cross section (RCS) to obtain a 3-D representation of the aircraft engine (see figures 1-4); but does not teach methods of impedance matching of cylindrical objection relating to FEM.
>
> Greenwood teaches encompassing FEM with impedance matching techniques to eliminate backscatter from body of revolution (BOR). The BOR is composed of a perfect conductor and impedance surface and arbitrary inhomogeneous materials. The method uses edge-based vector basis functions to expand the transverse field components and node based scalar basis functions to expand the angular moment. The use of vector basis functions eliminates the problem of spurious solutions suffered by three component FEM formulations (abstract).
>
> One of ordinary skill in the art at the time of invention would have modified the teachings of Ross in view of Greenwood because: 1) reflections indicate wasted energy and 2) by doing, so thus eliminates spurious emission from the waveguide so as to have proper 3-D representation of the aircraft part (see pg. 620-623).

Applicants respectfully traverse the rejection of claim 12 under 35 U.S.C. § 103(a).

The Ross Article is directed to the use of a limited mode phenomenon for a model for radar scattering and modulation from jet engines as discussed in greater detail above.

The Greenwood Article, as understood, is directed to a method to compute scattering from a complex body of revolution.

Applicant submits that dependent claim 12 is distinguishable from the Ross Article and/or the Greenwood Article for at least the following reasons. To begin, dependent claim 12 is believed to be distinguishable from the Ross Article and/or the Greenwood Article as depending from what is believed to be allowable independent claim 1 as discussed above. Furthermore, there is nothing in the Greenwood Article that teaches or suggests any of the limitations in independent claim 1 not taught or suggested by the Ross Article.

Applicant respectfully submits that the Examiner has improperly combined the Ross Article and the Greenwood Article. "The mere fact that references <u>can</u> be combined or modified does not render the resultant combination obvious unless the prior art suggests the desirability of the combination." *See* Manual of Patent Examining Procedure, 8th Edition (MPEP), Section 2143.01.

Therefore, in view of the above, dependent claim 12 is believed to be distinguishable from the Ross Article and/or the Greenwood Article and therefore are not anticipated nor

rendered obvious by the Ross Article and/or the Greenwood Article. In addition, claim 12 recites further limitations that distinguish over the applied art. In conclusion, it is respectfully submitted that claim 12 is not anticipated nor rendered obvious by the Ross Article and/or the Greenwood Article and is therefore allowable.

The Examiner rejected claims 10 and 11 under 35 U.S.C. § 103(a) as being unpatentable over the Ross Article in view of the Lowther et al. article entitled "A Finite Element Technique for Solving 2-D Open Boundary Problems," hereafter referred to as "the Lowther Article."

Specifically, the Examiner stated that

> Ross et al teaches a radical reduction in the complexity of the model for radar and modulation form jet engines, which encompass using finite element method (FEM) (pg. 31, paragraph 2) and radar cross section (RCS) to obtain a 3-D representation of the aircraft engine (see figures 1-4); but does not teach super elements.
>
> Lowther et al teaches a finite recursion technique for a solution for creating a super element, thus reducing nodes (abstract; figure 1).
>
> One of ordinary skill in the art at the time of invention would have modified the teachings of Ross in view of Lowther, since creating a super-element reduces the amount of nodes in a special area, thus reducing the post-computation time.

Applicants respectfully traverse the rejection of claims 10 and 11 under 35 U.S.C. § 103(a).

The Ross Article is directed to the use of a limited mode phenomenon for a model for radar scattering and modulation from jet engines as discussed in greater detail above.

The Lowther Article, as understood, is directed to a finite element recursion technique.

Applicant submits that dependent claims 10 and 11 are distinguishable from the Ross Article and/or the Lowther Article for at least the following reasons. To begin, dependent claims 10 and 11 are believed to be distinguishable from the Ross Article and/or the Lowther Article as depending from what is believed to be allowable independent claim 1 as discussed above. Furthermore, there is nothing in the Lowther Article that teaches or suggests any of the limitations in independent claim 1 not taught or suggested by the Ross Article.

Applicant respectfully submits that the Examiner has improperly combined the Ross Article and the Lowther Article. "The mere fact that references <u>can</u> be combined or modified does not render the resultant combination obvious unless the prior art suggests the desirability of

the combination." *See* Manual of Patent Examining Procedure, 8th Edition (MPEP), Section 2143.01.

Therefore, in view of the above, dependent claims 10 and 11 are believed to be distinguishable from the Ross Article and/or the Lowther Article and therefore are not anticipated nor rendered obvious by the Ross Article and/or the Lowther Article. In addition, claims 10 and 11 recite further limitations that distinguish over the applied art. In conclusion, it is respectfully submitted that claims 10 and 11 are not anticipated nor rendered obvious by the Ross Article and/or the Lowther Article and are therefore allowable.

Rejection under 35 U.S.C. 112

The Examiner rejected claims 7, 9-11, 14, 15, 19 and 20 under 35 U.S.C. 112, second paragraph. The Examiner stated that

> Where applicant acts as his or her own lexicographer to specifically define a term of a claim contrary to its ordinary meaning, the written description must clearly redefine the claim term and set forth the uncommon definition so as to put one reasonably skilled in the art on notice that the applicant intended to so redefine the claim term. ... The term "pipe" in claims 7, 9-11, 14, 15, 19 and 20 is used by the claim to mean "waveguide" or "transmission lines".

Applicant respectfully traverses the rejection of claims 7, 9-11, 14, 15, 19 and 20 under 35 U.S.C. 112, second paragraph.

First, Applicant disagrees with the Examiner that the term "pipe," which it is noted is recited in the claims as a "reference pipe," is used contrary to its ordinary meaning. One definition for a pipe is "anything tubular in form." *See* Webster's New World College Dictionary, Fourth Edition. (A copy of this definition can be provided upon the Examiner's request.) This definition of pipe is consistent with Applicant's usage of the term "reference pipe" in the claims. Furthermore, Applicant has clearly described in Applicant's Specification the "reference pipe" recited in the claims. Specifically, Applicant has stated that "[t]he infinite pipe is a numerical model of a very long pipe or cavity filled with an extremely low loss material to dampen the propagating electromagnetic field, thereby eliminating any reflection from the far end of the pipe." *See* Applicant's Specification, page 9, lines 11-13. In addition, the infinite pipe is further described in detail in Applicant's Specification at page 9, lines 3-29. Thus, since Applicant has recited the term "reference pipe" in the claims in accordance with its ordinary

meaning and in accordance with the description in Applicant's Specification, it is submitted that the term "reference pipe" is not indefinite and complies with 35 U.S.C. 112, second paragraph.

Therefore, in view of the above, Applicant submits that claims 7, 9-11, 14, 15, 19 and 20 are not indefinite and comply with the provisions of 35 U.S.C. 112, second paragraph, and therefore are allowable.

Objection to the Drawings

The Examiner objected to the drawings because Figures 1-3 should be labeled as prior art. Specifically, the Examiner stated that "[t]hese figures merely illustrate well known concepts of transmission lines and FEM.

Applicant respectfully traverses the objection to the drawings.

Applicant disagrees with the Examiner's characterization of Figures 1-3 as "prior art" and submits that the Figures show concepts associated with Applicant's invention and, as such, are not prior art. Specifically, the Examiner is referred to 37 C.F.R. 1.81(b) which states that "[d]rawings may include illustrations which facilitate an understanding of the invention." In the present Application, Figures 1-3 provide illustrations of concepts that are used in understanding Applicant's invention and, as such, are not old or "prior art." Furthermore, it is unclear how Applicant's basic design model illustrated in Figure 1 and described in Applicant's Specification at page 4, lines 11-27 can be considered "well-known."

Therefore, in view of the above it respectfully requested that the Examiner reconsider and withdraw the objection to the drawings.

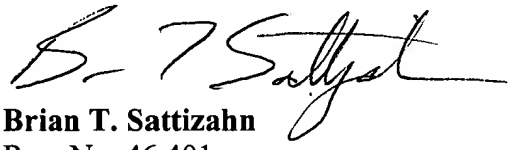
CONCLUSION

In view of the above, Applicant respectfully requests reconsideration of the Application and withdrawal of the outstanding objections and rejections. As a result of the amendments and remarks presented herein, Applicant respectfully submits that claims 1-20 are not anticipated by nor rendered obvious by the Barka Article, the Ross Article, the Kameari Article, the Greenwood Article, the Lowther Article or their combination and thus, are in condition for allowance. As the claims are not anticipated by nor rendered obvious in view of the applied art, Applicant requests allowance of claims 1-20 in a timely manner. If the Examiner believes that prosecution

of this Application could be expedited by a telephone conference, the Examiner is encouraged to contact the Applicant.

The Commissioner is hereby authorized to charge any additional fees and credit any overpayments to Deposit Account No. 50-1059.

Respectfully submitted,
McNEES, WALLACE & NURICK

By 

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